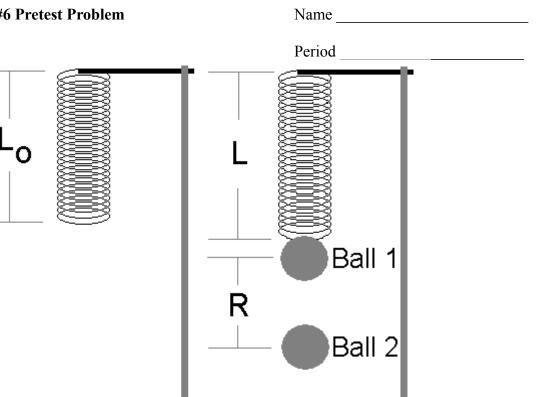
## AP Physics C Test #6 Pretest Problem



A student performs an experiment to measure  $\varepsilon_0$ , the permittivity of free space. The apparatus used consists of a spring with an unstretched length of  $L_0 = 10.0$  cm that is hung from a ring stand. Ball 1, with a mass of 50 g, is then hung from the spring and allowed to come to rest at its equilibrium position. The length L of the spring is measured at this equilibrium position and found to be 10.5 cm. A charge of 30 nC is placed on Ball 1 and a charge of 6  $\mu$ C is placed on a second ball, Ball 2. Ball 2 is then placed at various distances **R** from Ball 1 and the length of the spring is measured for each equilibrium position of Ball 1. The data the student collected is displayed in the chart below.

R (cm)	L (cm)	
2.0	14.6	
2.5	13.1	
3.0	12.3	
3.5	11.8	
4.0	11.5	

1) What is the value of the force constant **k** for the spring in this experiment?

2) Derive an algebraic expression for  $\Delta x$  (the change in length of the spring) in terms of  $q_1$  and  $q_2$  (the two charges on the balls), k (the force constant, not Coulomb's constant), R,  $\epsilon_0$  and any other fundamental constants necessary. Do not substitute any known values into your expression.

3) The student wishes to make a linear graph of the data collected. What values should be graphed according to your expression from question #2? Fill in the blank columns in the data table with the values. Be sure to include a column header and the proper units.

4) Make a linear graph of the two values you identified in question #3. Be sure to properly label and number the axes of the graph and include a best fit line for the data points.


5) Calculate an experimental value of  $\varepsilon_0$  from the slope of your graph.